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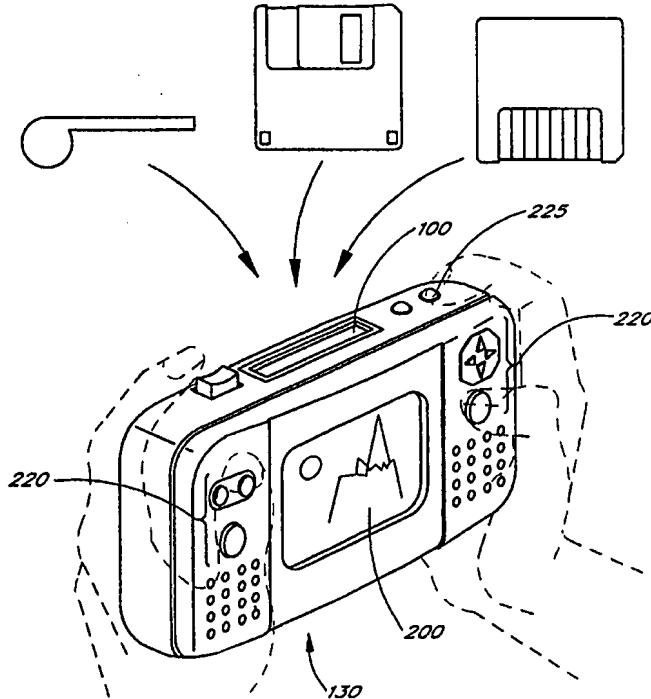
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(54) Title: ELECTRONIC PHOTO ALBUM AND METHOD OF FILM PROCESSING

(57) Abstract

An electronic photo album is described (Fig. 3A). The electronic photo album provides a way to share electronic photographs with the same ease that regular photographs are shared. The electronic photo album includes a display (200) for reviewing the digital images and an interface (100) to receive images from a digital camera, a flash card, a floppy disc, and the like. The electronic photo album stores digital images internally in a mass storage device configured as a disc drive, flash ram, and the like. On command, the electronic photo album displays the stored images on the display (200) for people to look at and share. The photo album also provides image output capability for displaying the images on televisions, computer monitors, printers, etc.



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ELECTRONIC PHOTO ALBUM AND METHOD OF FILM PROCESSING

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Background of the InventionField of the Invention

The invention relates to portable devices for displaying, editing, storing, transmitting, receiving, and manipulating digital images.

Background

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Historically, computer users who wanted to create digital images on a computer screen would start with a conventional photographic image on a print, negative, or slide. The photographic image was then converted into a digital image by using a scanner to scan the photographic image into a computer.

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The introduction of the digital camera allowed users to bypass the film development and scanning process. With a digital camera, the user simply takes a picture and downloads the picture into a computer. The image quality of the early digital cameras was poor, and the cameras themselves were very expensive. Thus, for a time, many photographers both amateur and professional continued to use conventional film photography. Recently, the quality of the photographs produced by digital cameras has improved dramatically, and the price of the digital cameras has declined to the point where a digital camera is a consumer item used by professional and amateur photographers. Many observers and photographers now predict that, in the near future, electronic photography will replace conventional film photography for most purposes.

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However, the digital camera, while providing many benefits over a conventional film camera does have some drawbacks. One of the biggest drawbacks is that the digital images cannot be placed in a photo album like a normal photograph. The digital

images are, in a sense, less portable than regular photographs because a computer with a display screen is needed to view the digital images. This makes it difficult for photographers, especially amateur photographers showing family and vacation pictures, to show their photographs to others. In addition, many digital cameras have limited storage capability and cannot store a large number of digital images.

Summary of the Invention

The present invention solves these and other problems by providing a portable electronic photo album configured to store and display digital images. The electronic photo album provides a memory for storing the digital images, a processor to process the images, and a display to show the images. The electronic photo album also provides an interface to a source of digital images. Sources of images include digital cameras, computers, floppy discs, flash ram cards, and the like.

The electronic photo album provides a convenient way to share electronic photographs with the same ease that conventional photographs are shared and exchanged. The electronic photo album electronically displays images that have been captured and processed by a digital camera, computer, and the like. The electronic photo album can be used to transport thousands of digital images and to display those digital images in different forms for different users. The electronic photo album stores the digital images on a mass storage device such as a hard disc, a flash memory, and the like. On user command, the electronic photo album displays the stored images on the display. In one embodiment, the electronic photo album provides an output signal to display the images on an external display device such as a television, computer monitor, projector, virtual-reality display, printer, etc. The electronic photo album can provide digital image output directly or indirectly to photo printers, the Internet, and a photo kiosk that provides printing services for digital images.

In one embodiment, the electronic photo album is configured to contain electronic components, connectors, batteries, and an interface to an electronic film unit. In one version, a direct connection is provided between the electronic film unit readout connector and a computer via connectors and wiring. In other versions, interfaces to a PCMCIA port that contain memory circuits with card type/identifying data, a USB Port controller or even a telephone or network modem may be included within the electronic photo album.

The electronic photo album can be configured with memory (FLASH Memory, for example) and with data transfer and control means to transfer data from an inserted electronic film unit into the electronic photo album memory and then erase the electronic film unit memory, allowing for immediate reuse of the electronic film unit to take additional pictures. The electronic photo album, with or without the electronic film, may be connected to a computer so that the data can be transferred to the computer and the memory within the electronic photo album (and electronic film unit, if present) can be erased. This configuration is useful, for example, when traveling and direct computer download of each electronic film unit "roll" of pictures is not convenient.

In yet another embodiment, the electronic photo album includes a processor to compress and store images. As a further extension of the above electronic photo album configuration, processor can perform image-processing functions prior to storing of the images into the memory of the electronic photo album.

Image data from the electronic film unit can be compressed using JPEG, Wavelet, Fractal, or other compression algorithms as part of the storage process. This has the advantage of reducing the amount of data stored and conversely increasing the capacity of the image storage capacity of the electronic photo album.

In one version, the present system is an integrated approach to providing an electronic photo album, or memory book, that can be used to transport thousands of images and to display those images in different forms for different people, with a built-in display capability for looking at the images. The system can receive images from the electronic film system (E-Film), from computers, from digital cameras, or from the Internet, or virtually any way the user wants to input the digital image. The memory book stores the images on a mass storage device(s) such as hard drives, floppy discs, electronic flash drives or other current and future types of mass storage media. The memory book, on command, displays the images on its built-in screen for people to look at and to share. It can output the images to other types of displays such as televisions, PC monitors, and export them to the web to be shown to other people on the Internet or through the projector-type of image displays which interface with PC's. In addition, the use can output images to print systems that can make hard copies. The memory book can output either directly or indirectly to photo printers, directly or

indirectly via the web to a printing organization, or output directly to something like a photo kiosk which provide printing services of digital images (similar to those that are built by Kodak, Fuji, and others).

5 In one embodiment, the memory book provides portability, size, and the uniqueness of the memory book functionality. It stores, displays, and provides a means of sharing thousands of images.

10 In one version, the memory book includes a means for capturing electronic imagery from digital imaging devices or sources, displaying and/or processing those images, editing the images (optionally), and sharing the images with other media or directly with other people. Other media include computers, televisions, printers, web sites and/or developers as well as any unnamed or future versions of image media and the like. In one aspect, the memory book is a large photo album that accepts digital images and then allows a person to share those images with other people.

15 In one embodiment, size and portability are features of the concept. In one embodiment, the memory book is very small, on the order of the size of a large paperback novel that can hold thousands of images, transport the images, and share the images with other people. In addition, the user can flip through images and albums just as he or she would through a traditional album or stack of albums. In one embodiment, within the memory book, there are multiple albums. A user can choose which album to 20 share with what individuals on what date.

25 The memory book includes an input port of sufficient bandwidth to easily import the images; sufficient data storage space for image storage; and a display mechanism for the digital image display. The memory book provides a convenient way to manage the increasing amount of imagery available throughout the world which is only available in digital form, and has never been reduced to a negative or to a print. Thus, the memory book becomes a natural adjunct system for digital image sharing.

Brief Description of the Figures

The various embodiments of the invention are described below in connection with the following figures.

30 Figure 1 shows an electronic film cartridge that fits within a film cavity of a standard 35 mm camera.

Figure 2 shows an alternate view of the electronic film cartridge.

Figures 3A-3C show an electronic photo album having a first case style, a connector for an electronic film cartridge (or other source of digital images) and a display for viewing the images.

5 Figures 3D-3F show an electronic photo album having a second case style, a connector for an electronic film cartridge (or other source of digital images) and a display for viewing the images.

Figure 4 shows a block diagram of the electronic photo album.

Figure 5 is a flowchart showing user interaction with the electronic photo album.

10 Figure 6 is a block diagram that shows one embodiment of the logical storage of images as one or more logical volumes (logical albums) in an electronic photo album.

Figure 7A is a flowchart that illustrates input-output data flow in the electronic photo album.

15 Figure 7B is a flowchart that illustrates image processing in the electronic photo album.

Detailed Description of the Preferred Embodiment

One embodiment of the invention is used in connection with an electronic film cartridge 100 shown in Figure 1. The electronic film cartridge 100 fits within a film cavity of a camera 110 such as a standard 35 mm camera. The electronic film cartridge 20 100 is preferably shaped so that it can mate directly with the camera 110 without modifications being made to the camera. Placing the electronic film cartridge 100 into the camera 110 effectively turns the camera into a digital camera, offering the user the ability to rapidly switch between conventional and electronic photography, while still providing the user the freedom to use camera attachments and other lenses. This offers the user both 25 simplicity and convenience.

Another view of the electronic film cartridge 100 is shown in Figure 2. The cartridge 100 is advantageously capable of recording quality images with over 1.0 megapixel resolution, and includes a non-volatile storage (e.g., flash memory) capable of storing many full resolution pictures. The cartridge 100 may be reused many times, 30 resulting in significant savings in film and film development. When it is not in use, the cartridge 100 is preferably stored in a molded carrying case (not shown). To load the

cartridge 100 into the camera 110, the cartridge is taken out of the carrying case and placed into the body of the camera like a conventional roll of film, with the cartridge 100 being self-seating within the camera. Once the camera 110 is closed, the user is ready to take pictures. A visible display 120 on the cartridge 100 confirms that the cartridge is ready to record the next picture (generally within 2 seconds of the picture just recorded), and this may be confirmed by an audible signal from the cartridge 100. The display 120 also preferably provides a shot counter, and the electronic film cartridge 100 alerts the user with an audible alarm when the system is full. In one embodiment, the photographic speed (ASA) of the electronic film may be 64 or greater.

10 Pictures, as digital images, recorded electronically are advantageously stored and viewed using a electronic photo album 130 as shown in Figures 3A-3F. A first case style is shown in Figure 3A-3C, a second case style is shown in Figures 3D-3F. The electronic photo album 130 has a cavity for accepting the electronic film cartridge 100, a flash ram card, a floppy disc, flash ram, or other storage device suitable for storing digital images.

15 To facilitate data transfer between the cartridge 100 and the electronic photo album 130, the cartridge 100 typically includes electrical contacts that mate with electrical contacts in the electronic photo album 130 when the cartridge is properly inserted into the electronic photo album. The electrical contacts are connected to an interface within the electronic photo album 130, with at least one battery 303 supplying power to the electronics within 20 the electronic photo album. The electronic photo album 130 can advantageously transmit or receive digital images over telephone lines using a built-in modem and a phone jack 320 (e.g., an RJ-11 jack).

25 In one embodiment, the electronic photo album 130 stores many pictures, which are displayed on a display 200, as illustrated in Figure 3A-3F. Using control buttons or knobs 220, a user can select stored picture for viewing. In one embodiment, the electronic photo album 130 functions as a multi-volume photo album, and the memory within the electronic photo album may be advantageously partitioned into several volumes, (e.g., multiple photo albums). The user has the option of selecting one of a number of industry standard formats for the images: JPEG, FLASHPIX, BMP, etc. The electronic photo 30 album 130 preferably further comprises a set of icons on the display and/or, optionally,

other indicators (e.g., light emitting diodes or "LEDs") which indicate the status of the electronic processing, as described in greater detail below in connection with Figure 6.

The electronic photo album 130 can also be used to share digital images by several methods. One such sharing method includes downloading images to a home computer and uploading images from a home computer. Optional sound files associated with the digital images can also be uploaded and downloaded to the computer.

A cartridge door 333, shown closed in Figure 3D, and open in Figures 3E and 3F, is provided with the second case style to cover the opening where the electronic film cartridge 100 is inserted. The cartridge door 333 can also be provided with the first case style shown in Figures 3A-3C.

Figure 4 is a block diagram showing the functional components of the electronic photo album 130. In Figure 4, an external storage device 400 is provided to an interface 410 that is linked to a central processing unit (CPU) 420. The external storage device 400 can be an electronic film cartridge 100, a floppy disc, a miniature floppy disc, a flash ram, a solid state floppy disc card (SSFDC), a disc drive, an electronic camera, or any other data storage device. The CPU 420 is in communication with a memory 430 and an internal storage device 430. The CPU 420 is also in communication with a display screen 200, an optional external display interface 450, and an optional computer interface 460. The computer interface 460 provides connection to an external computer 404. The computer interface 460 can be a parallel port interface, a serial port interface, a Universal Serial Bus (USB) interface, a FireWire interface (e.g., IEEE-1394), an ethernet interface, a network interface, a radio frequency (RF) interface, an infrared interface, a PCMCIA port, and the like. The external computer 404 can be another electronic photo album, thereby allowing the sharing of images between photo albums. The computer 404 can also be a desktop personal computer or laptop. The external computer 404 can be provided with an interface to a communications network 441, such as the Internet, thereby allowing the electronic photo album 130 to indirectly download and upload pictures via the network (i.e., Internet) through the computer 404.

User commands from controls 464 are provided to the CPU 420. A power management system 462 supplies power to the various functional blocks of the electronic photo album 130 on an as-needed basis to conserve power.

In one version, the CPU 420 is also linked to an optional modem 440 through which data, including images and sound files, may be downloaded to a communications network 441 without the need for the computer 404. The communications network 441 can be the Internet, an intranet, and the like. The modem 440 can be configured to provide a connection through a Public Switched Telephone Network (PSTN), an Integrated Services Digital Network (ISDN), a cellular telephone network (including analog and digital systems), a satellite communications network (including, for example, the Iridium system), a cable television system and the like. The communication network 441 can be connected to a remote site 490 that is configured to store, print, and/or display the images.

The electronic photo album 130 can also include an optional audio output system 470, which includes a digital-to-analog converter 471, an amplifier 472 and a loudspeaker (and/or headphone connector) 473. An output of the processor 420 provides digital audio data to a digital input of the digital-to-analog converter 471. An analog output of the digital-to-analog converter 471 is provided to an input of the amplifier 472 and an output of the amplifier 472 is provided to the loudspeaker 473.

When a picture is viewed on the display 200, the audio system 470 can be used to play a digital-audio sound clip associated with the picture being viewed. The audio system 470 can also be used to provide user interface functions, such as a low-battery beep, a memory-full beep, etc.

The display 200 includes, for example, flat panel displays, liquid crystal displays, and the like. The external display interface 450 is configured as an interface to an external display/printer device 403. The external display/printer device 403 can be a video display device such as a television, a computer monitor, a flat panel display, an image projection system, a virtual-reality headset, a printer, and the like. In one embodiment, the video interface provides a standard analog NTSC (National Television Systems Committee) signal. In one embodiment, the external display interface 450 provides a digital video signal, such as, for example, an MPEG (Motion Picture Experts Group) signal, an HDTV (High Definition Television) signal, etc.

The display 200 is used to select the images that will be downloaded, to select the images that will be printed, and, optionally, to manipulate a selected image (e.g., crop the image, lighten the image, darken the image, etc.). The user can also use the display 200 to

review, organize, and select images that were previously downloaded and stored in the electronic photo album 130.

Figure 5 is a flowchart that illustrates user interaction with the electronic photo album 130. In Figure 5, the user provides digital images stored on an external device such as a flash ram card 502, an E-file cartridge 100, a computer 504, another electronic photo album (EPA), or other digital storage device. In a process block 505, the user connects the external storage device to the electronic photo album 130. After connecting the external storage device, the electronic photo album 130 is turned on and runs its power-up sequence in a process block 506. The power-up sequence advances to either a "too-cold" warning process block 507, a "low-battery" warning process block 508, or a media input process block 509. The warning process blocks 507 and 508 provide status messages to the user indicating that the memory book cannot be used due to an error condition.

In the media input process block 509, the electronic photo album 130 examines the data stored on the external storage device and begins a download operation. If, in the media input process block 509, the electronic photo album 130 detects that the external storage device is a flash ram card, the process advances to a flash card process block 510; otherwise, the process advances to a download block 511. In the download block 511, digital images from the external storage device are downloaded into the electronic photo album 130 and a "downloading" icon is displayed on the display 200. Once downloading is complete, the process advances to a process block 512 where the downloaded images are stored on the internal mass storage device in the electronic photo album 130. Images can be stored by date and by volume. If the process block 512 detects that the external storage device is an electronic film cartridge 100, then the process advances to an erase block 513, otherwise the process advances to a thumbnail block 516.

In the erase block 513, the memory in the electronic film cartridge is erased and the process advances to a process block 514 where the clock on the electronic film is updated from a clock in the electronic photo album 130. After updating the clock, the process advances to a process block 515 where a "remove" icon is displayed informing

the user that it is safe to remove the electronic film device. Upon displaying the "remove" icon, the process advances to the thumbnail process block 516.

In the thumbnail process block 516, a plurality of blank "thumbnail" (i.e., small) images are shown on the display 200 and the process advances to a process block 517.

5 In the process block 517, the downloaded images are processed (i.e. decompressed, dark current corrected, etc.) and as each image is processed, one of the blank thumbnail images is replaced by an actual thumbnail image of one of the downloaded digital images. A moving highlight cursor shows the user which thumbnail is being processed. When all thumbnail images have been processed the process advances to a process
10 block 518 where the thumbnail images are displayed.

Upon completion of the process block 518, the process advances to a process block 519 where the electronic photo album 130 accepts data manipulation commands from the user via the buttons and user controls 220 on the electronic photo album 130. From the process block 519, the user can advance to a view-full-image block 520, a
15 delete image block 522, or a view/select thumbnail images block 521.

From either the view-full-image block 520 or the view/select thumbnail images block 521, the process advances to data output process block 523. The data output process block 523 provides output of the viewed/selected digital images to a device such as a flash ram card 524, the computer 404, the display 403, the network 441, etc.

20 The user may also use the electronic photo album 130 in a recall/viewing mode to view images previously stored in the electronic photo album 130. The recall/viewing mode begins at a process block 526 and advances immediately to a process block 527 where the electronic photo album 130 is turned on. After turn-on, and a subsequent warm-up process block 528, the process advances to an icon display process block 529.

25 In the icon display process block 529, icons are shown on the display 200. The electronic photo album 130 allows the user to organize the images into multiple volumes (albums), where each volume is a collection of images. In other words, the physical album 130 can be configured as multiple logical albums. The icons give the user various choices for selecting a volume (or "roll") of images (an, optionally, sound
30 files) previously downloaded (as discussed in connection with Figure 6). The user choices include "select photo volume" and "delete volume." If the user selected the

“delete volume, the process advances to a delete process block 531. If the user selects the “select photo volume” the process advances to the process block 518 to display thumbnail images of the pictures in that volume. Thumbnail images are small images sized so that the thumbnail images for several complete pictures can be shown on the display 200 at one time.

Figure 6 is a block diagram that illustrates one embodiment of the logical storage of images in the electronic photo album 130. Figure 6 shows two volumes of images, a first volume 602 and a second volume 603. The first volume 602 contains images 610-614 and, optionally, sound files 630-634. Each sound file is associated with an image, and the sound files 630-634 are associated with images 610-614 respectively. The second volume 603 contains images 620-623 and, optionally, sound files 641-643.

As described in connection with Figure 5, organizing the images into volumes makes it easier for a user to manage a large number of images, because each volume typically contains only a subset of the total number of images stored in the electronic photo album 130. Images can be arranged in volumes according to date, according to subject, according to size, and by user selection. The user can delete a volume, download an entire volume, add or remove images from a volume, and display a volume. In one embodiment the electronic photo album 130 displays a volume by showing each image in the volume for a period of time and then automatically advancing to the next picture in the volume. When digital sound clips are provided, the sound clip associated with each picture is played while the picture is displayed.

Figure 7A is a data flowchart that illustrates one embodiment of an input/output signal processing sequence used by the electronic photo album 130. Figure 7A begins with a step 710 where image data is loaded from an external source such as the E-film cartridge 100, a computer, the internet, a digital camera, a scanner, and the like. Once the image data is loaded, the data advances to a process block 711 where the image data is stored on the internal storage device 402 and, optionally, displayed on the display 200.

Commands, such as commands from the user, are processed in a process block 714. In response to commands from the process block 714, an image output processing block 713 retrieves images from the internal storage device 402, formats the image data,

and sends the image data to a display device such as a printer, the internet, a photo-printer (e.g., a photofinisher that prints an image on photographic print paper), a television, a computer, a cellular telephone with an image display, other media, and the like.

5 Figure 7B is a flowchart that illustrates one embodiment of a signal processing sequence used by the electronic photo album 130. Figure 7B begins with a step 701 where an image is retrieved from either the internal storage device 402 or the external (removable) storage device 400. After retrieving the image, the image is decompressed in a process block 702 and passed to an image edit block 703. The image edit block 703 can also provide the uncompressed image to the display device 200.

10 In the image edit block 703 the image can be edited by the user. User edit functions include changing the image color balance, contrast, brightness, size. The user can also crop portions of the image and zoom-in on portions of the image.

15 The image edit block 703 also provides non-user controlled (e.g., automatic) image editing directed by the processor 420. In one embodiment, the processor 420 performs edge detection, gamma correction, and other image processing to enhance the appearance of the image when displayed on the display 200, the external display/printer 403, or the computer 404.

20 Upon completion of the edit block 703, the data is recompressed in a compression block 706. After compression, the process advances to a storage block 706 where the data is stored.

25 Although the foregoing has been a description and illustration of specific embodiments of the invention, various modifications and changes can be made thereto by persons skilled in the art, without departing from the scope and spirit of the invention as defined by the following claims.

WHAT IS CLAIMED IS:

1. A portable, handheld, electronic photo album that allows a user to easily store, carry, and view quality digital images, comprising:
 - 5 an interface configured to receive one or more digital images from a removable storage device;
 - a memory for storing said one or more digital images, said memory configured to allow a user to arrange said one or more digital images as one or more volumes; and
 - 10 a display for showing said one or more digital images.
- 15 2. The electronic photo album of Claim 1, wherein said display is configured to show a plurality of thumbnail images of said one or more digital images.
3. The electronic photo album of Claim 1, wherein said electronic photo album further comprises an output interface for displaying one or more of said digital images on an external display device.
- 15 4. The electronic photo album of Claim 3, wherein said external display device is a television.
5. The electronic photo album of Claim 3, wherein said external display device is a projector.
- 20 6. The electronic photo album of Claim 3, wherein said external display device is a computer monitor.
7. The electronic photo album of Claim 3, further configured to send a selected digital image to a cellular telephone for display by said cellular telephone.
8. The electronic photo album of Claim 3, wherein said external display device is a printer.
- 25 9. The electronic photo album of Claim 3, wherein said external display device is a virtual reality headset.
10. The electronic photo album of Claim 1, further comprising a modem.
11. The electronic photo album of Claim 10, wherein said modem is configured to download at least one of said one or more digital images to an Internet site.

12. The electronic photo album of Claim 10, wherein said modem is configured to download at least one of said one or more digital images through an Internet site to a remote display device.

5 13. The electronic photo album of Claim 10, wherein said modem is configured to download at least one of said one or more digital images to a remote display device.

14. The electronic photo album of Claim 13 wherein said external display device is a printer.

10 15. The electronic photo album of Claim 13 wherein said external display device is a photo-printer.

16. The electronic photo album of Claim 1, further comprising a computer interface.

17. The electronic photo album of Claim 1, where said external storage device is an electronic film cartridge.

15 18. The electronic photo album of Claim 1, where said external storage device is a disc.

19. The electronic photo album of Claim 18, where said disc is an optical disc.

20 20. The electronic photo album of Claim 18, where said disc is a magnetic disc.

21. The electronic photo album of Claim 1, where said external storage device is a flash memory.

22. The electronic photo album of Claim 1, where said external storage device is a non-volatile memory.

25 23. The electronic photo album of Claim 1, further comprising a digital audio system configured to play digital audio files associated with said one or more digital images.

24. A method for easily storing, carrying, and viewing digital images, comprising the steps of:

30 receiving one or more digital images from an external storage device;

storing said digital images as in one or more volumes in a first compressed data format;

selecting one of said digital images as a selected image;

decompressing said selected image to produce a decompressed image;

5 displaying said decompressed image on a display.

25. The method of Claim 24, further comprising the step of processing said decompressed image to enhance viewability of said decompressed image.

26. The method of Claim 24, further comprising the step of compressing said decompressed image using a second compression algorithm to produce a recompressed 10 image and storing said recompressed image in one or more of said volumes.

27. A portable, handheld, electronic photo album that allows users to easily store, carry, and view digital images, comprising:

an interface configured to receive one or more digital images from a removable storage device;

15 a memory for storing the digital images, said memory configured to allow a user to arrange said one or more digital images as one or more volumes; and;

display means for displaying said image.

28. An electronic photo album, comprising:

20 an interface configured to receive one or more digital images from a removable storage device;

storage means for storing said one or more digital images, said storage means configured to allow a user to arrange said one or more digital images as one or more volumes; and

25 display means for displaying said image.

29. An electronic photo album, comprising:
- an interface configured to receive one or more digital images from a removable storage device;
- 5 a memory for storing digital images, said memory configured to allow a user to group a first plurality of said digital images in a first logical volume and to group a second plurality of digital images in a second logical volume; and
- a display for showing said digital images.

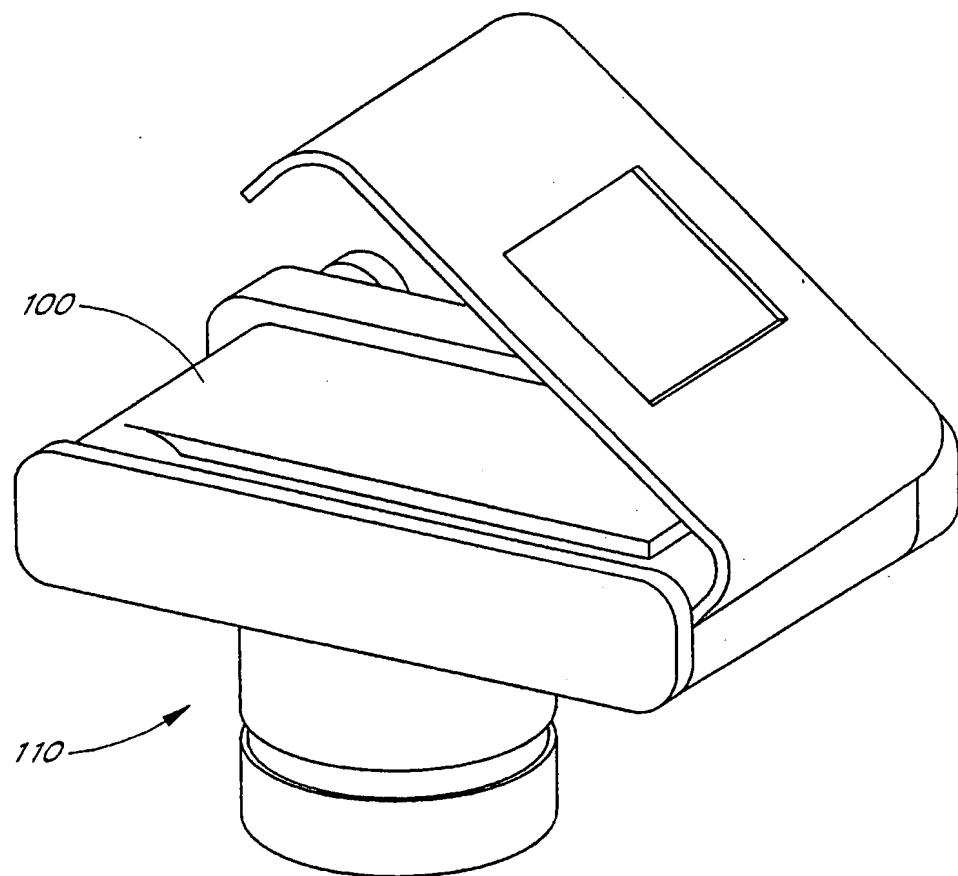


FIG. 1

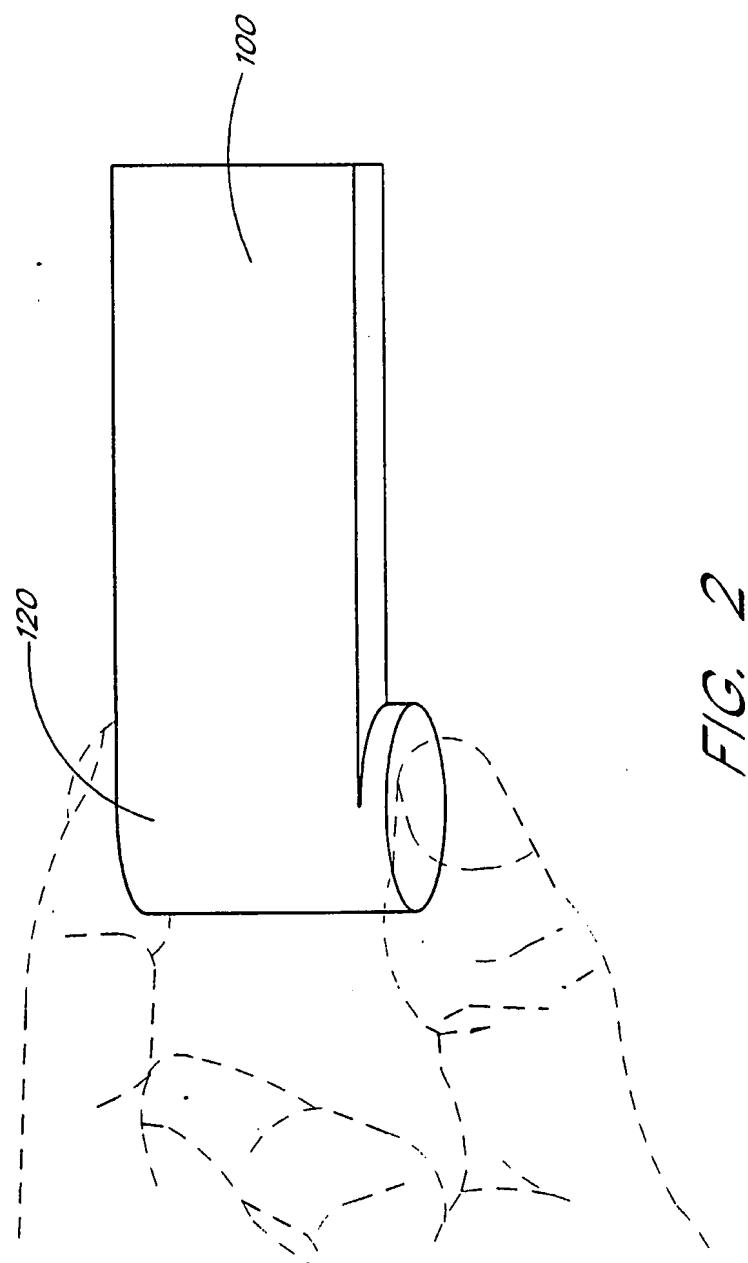


FIG. 2

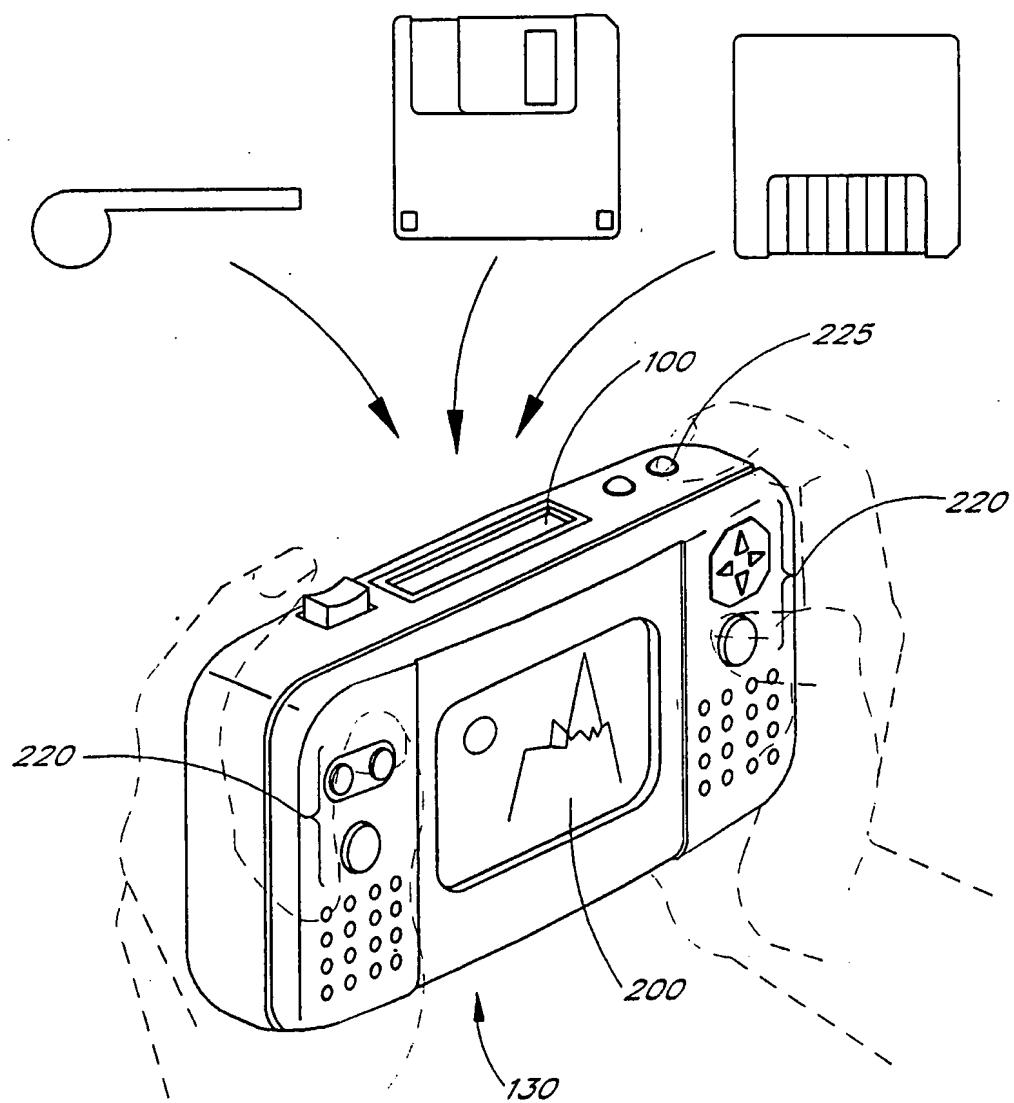


FIG. 3A

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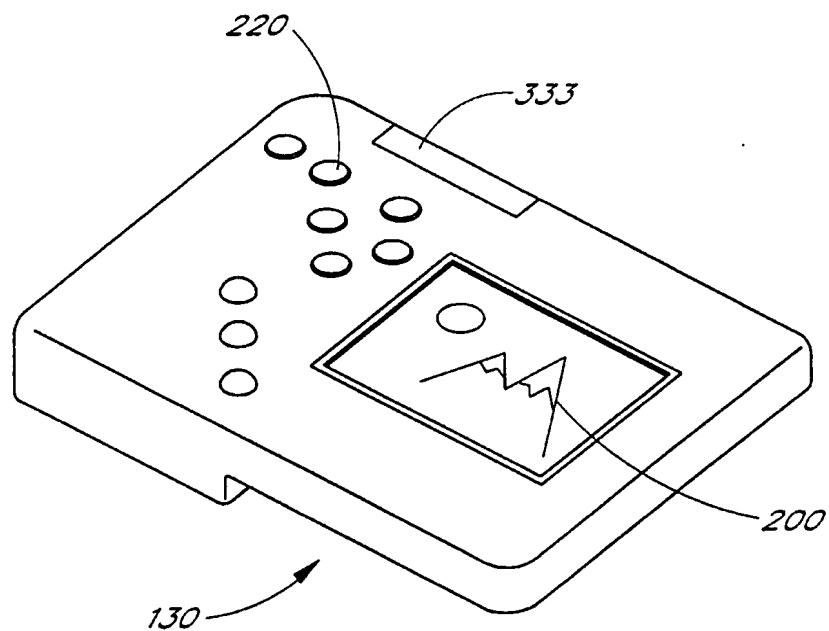


FIG. 3D

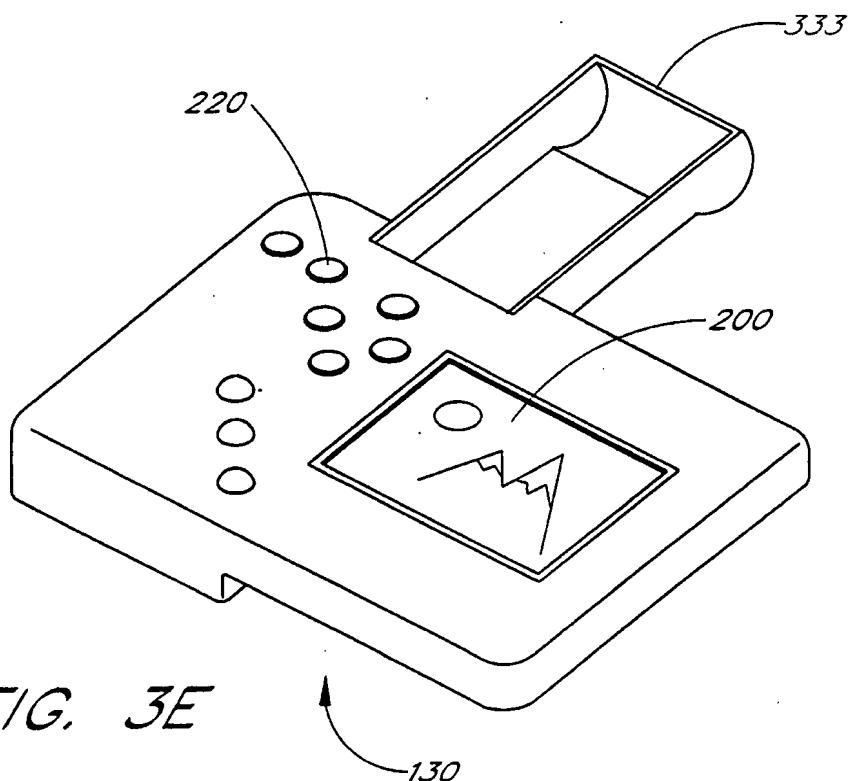


FIG. 3E

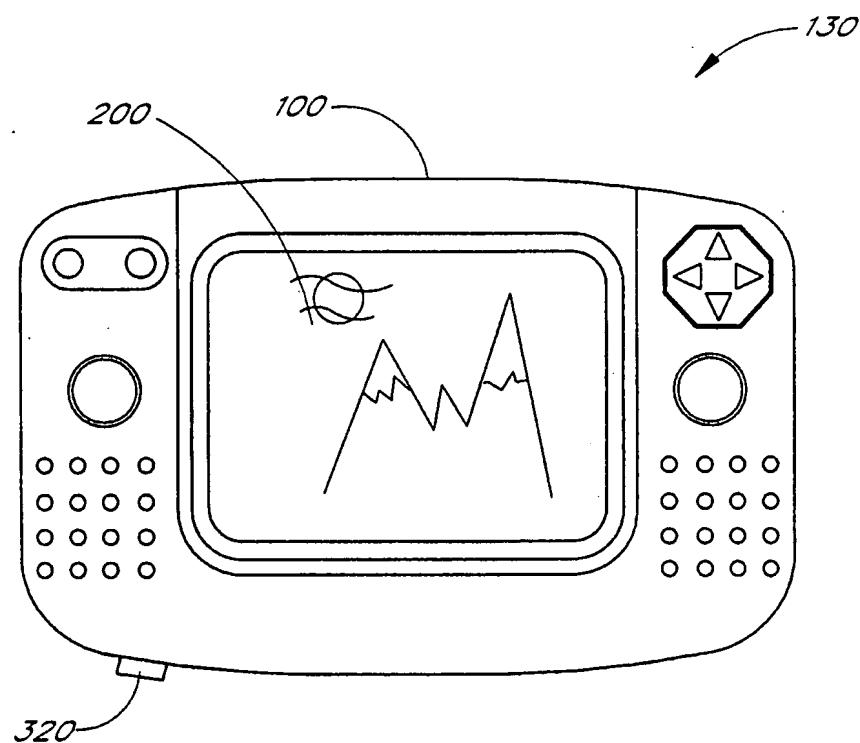


FIG. 3B

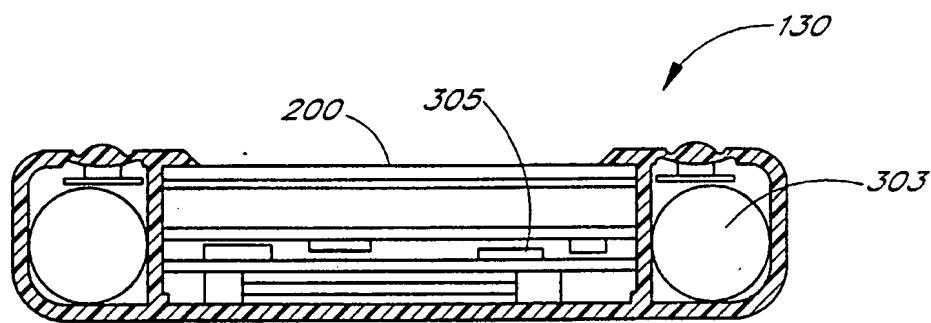


FIG. 3C

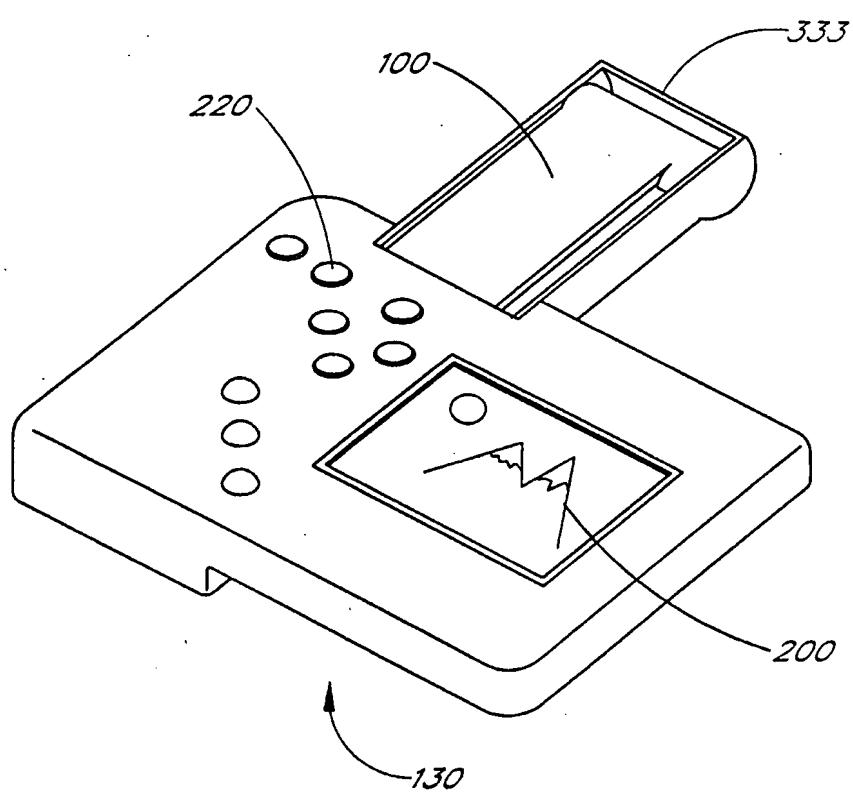


FIG. 3F

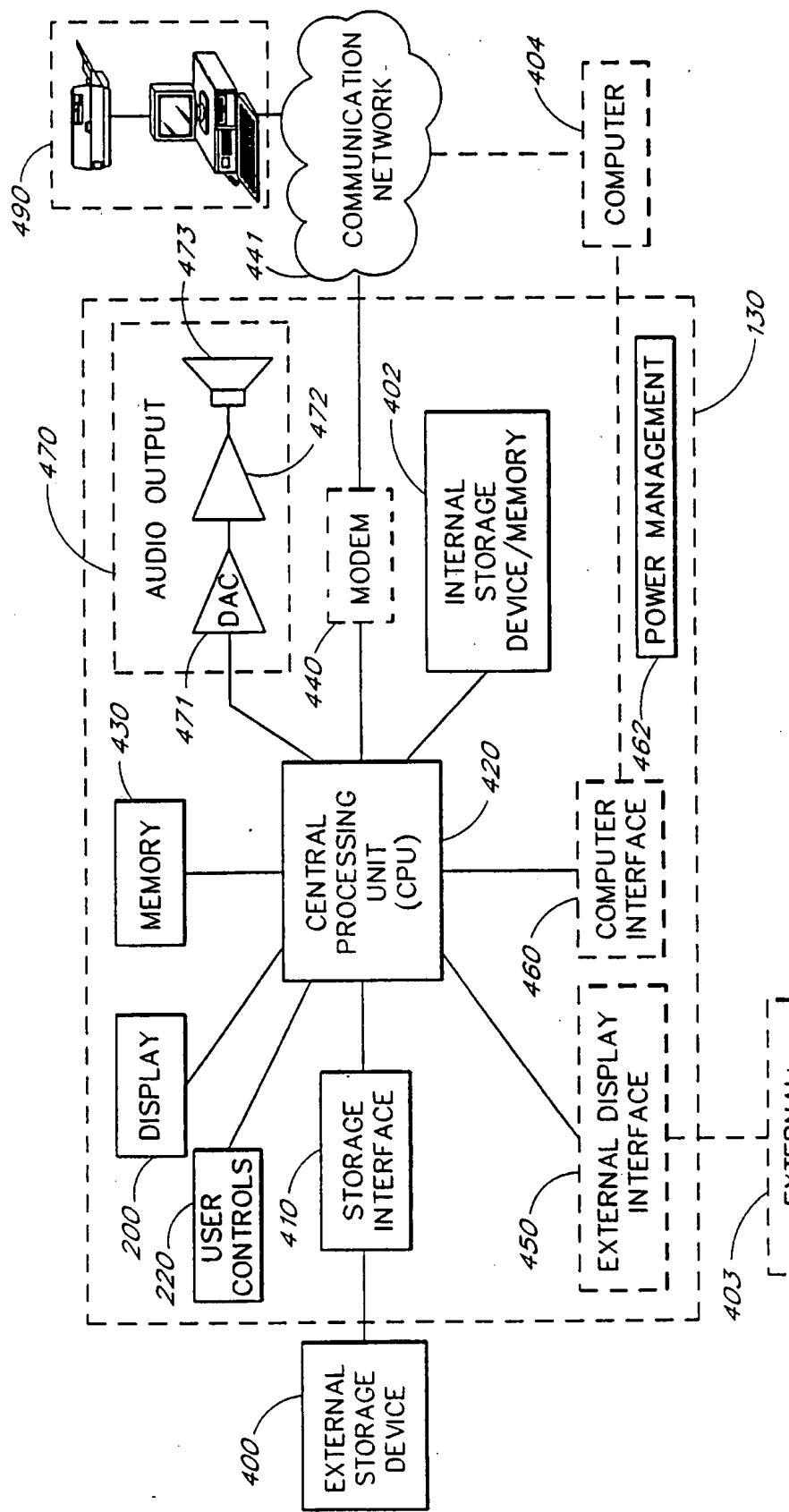
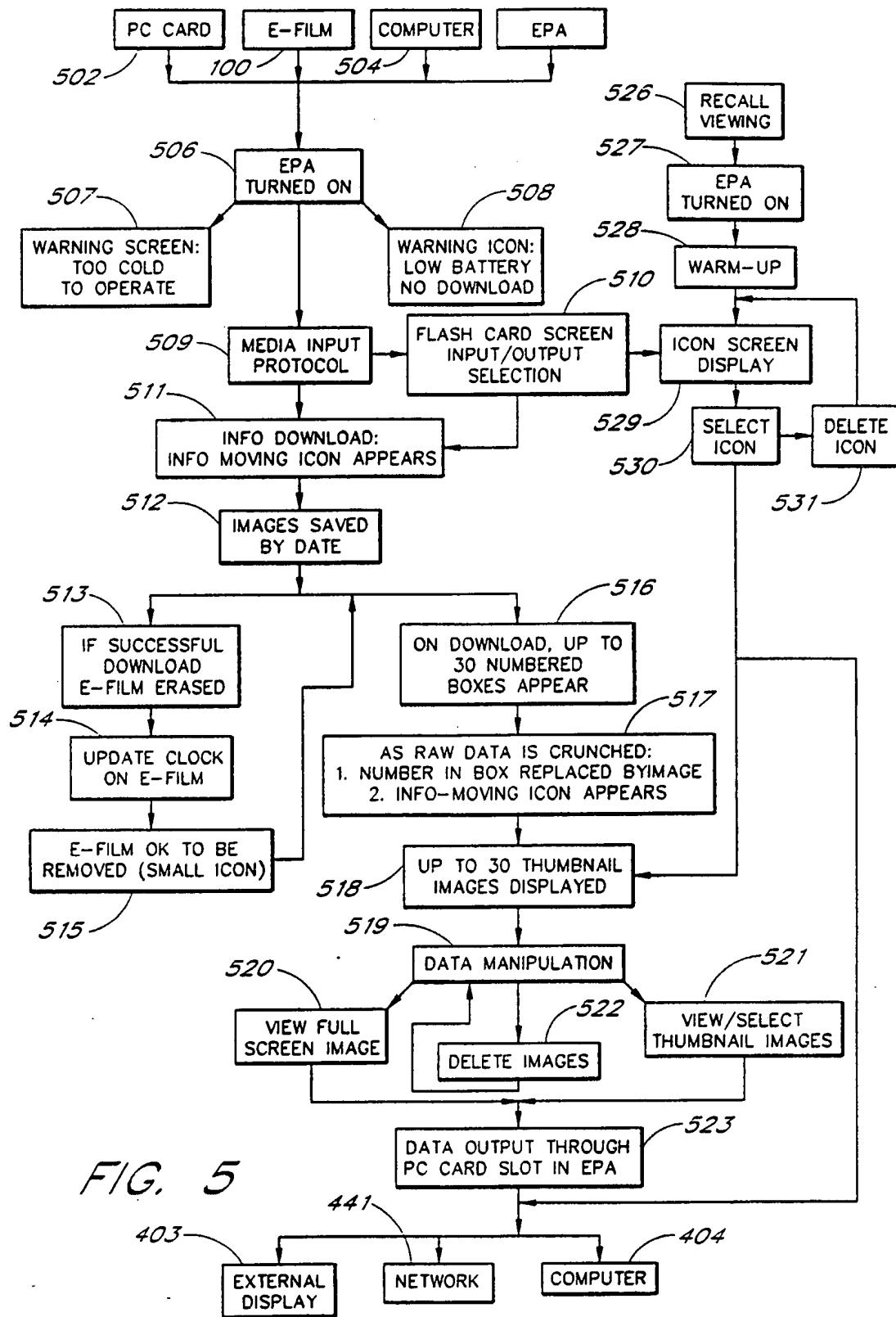


FIG. 4



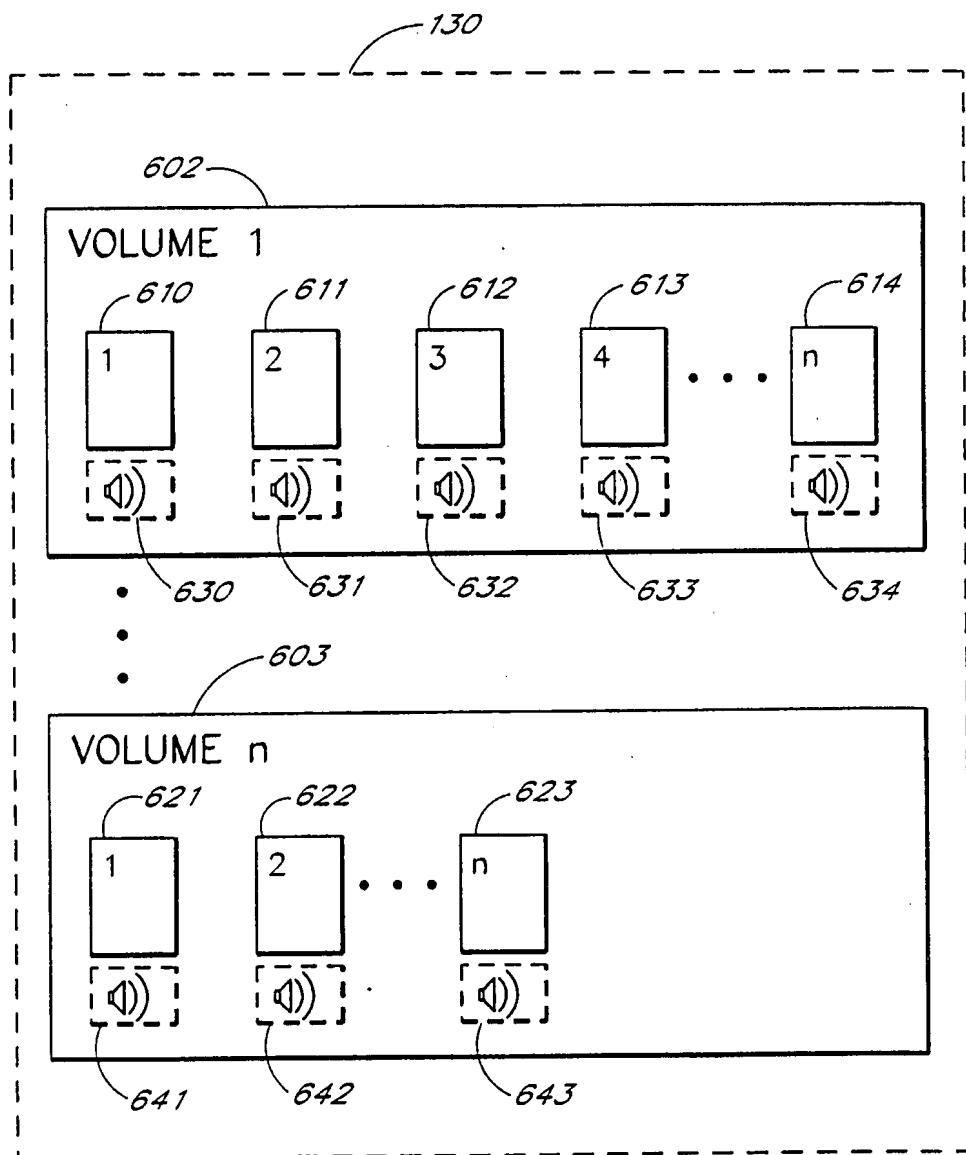


FIG. 6

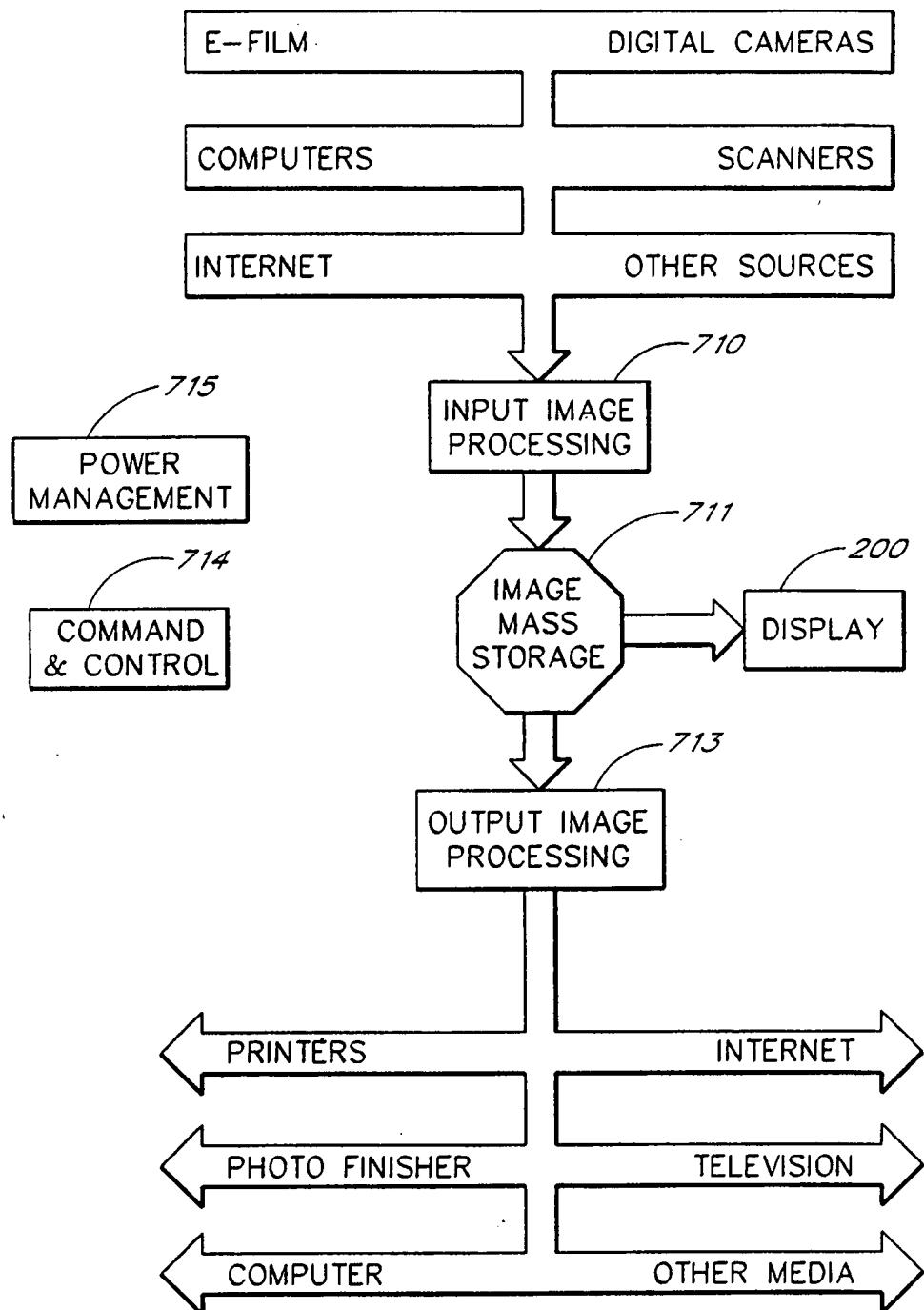


FIG. 7A

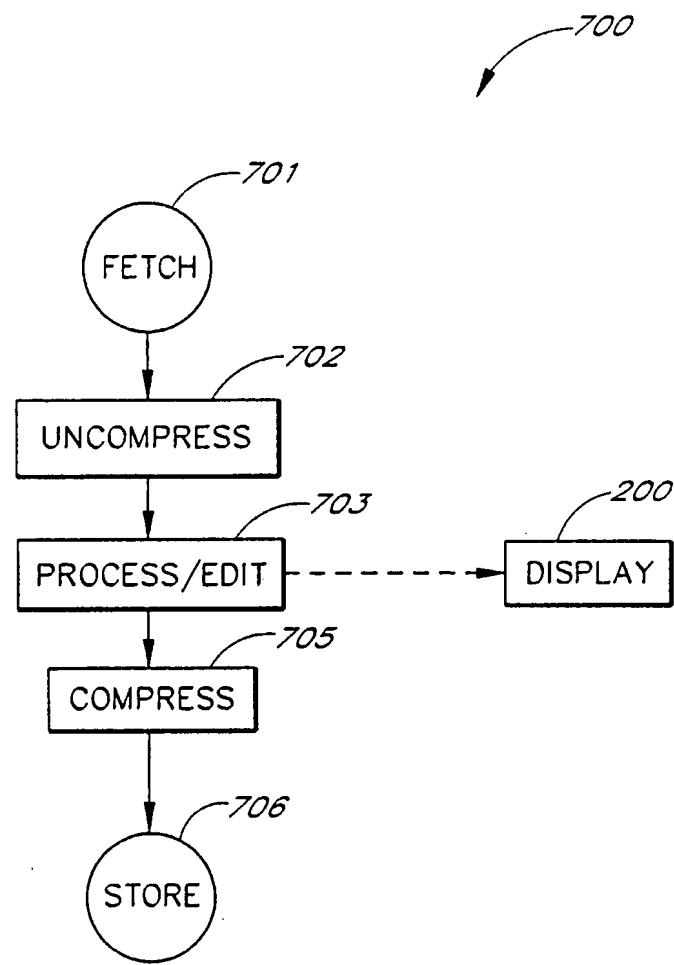


FIG. 7B

INTERNATIONAL SEARCH REPORT

| |
|---|
| International application No. PCT/US99/09013 |
|---|

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :H04N 5/30, 5/225
 US CL :345/202,203,507; 348/333,334; 396/310

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 345/202,203,507; 348/333,334; 396/310

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|-----------|--|-----------------------|
| Y | US 5,164,831 A (Kuchta et al) 17 November 1992, col. 2, lines 30-32 and 19-21. | 1-28 |
| Y | US 5,541,656 A (Kare et al) 30 July 1996, col. 3, lines 20-39. | 1-28 |
| Y, P | US 5,845,161 A (Schrock et al) 1 December 1998, col. 3, lines 30-44. | 1-28 |

Further documents are listed in the continuation of Box C. See patent family annex.

| | | |
|---|-----|--|
| • Special categories of cited documents: | "T" | later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention |
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| •B• earlier document published on or after the international filing date | "Y" | document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art |
| •L• document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) | "A" | document member of the same patent family |
| •O• document referring to an oral disclosure, use, exhibition or other means | | |
| •P• document published prior to the international filing date but later than the priority date claimed | | |

Date of the actual completion of the international search

07 JULY 1999

Date of mailing of the international search report

17 AUG 1999

Name and mailing address of the ISA/US
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